CONTENTS.

VOL. XXII.

Page.

Absolute Zero..... 168, 279
Accident from dynamite..... 264
Acoustic properties of buildings. 369
Acoustics of large halls..... 153
Adelaide sewers..... 88
American Man-of-War..... 450
Ancient mines in England..... 175
Ancient petroleum..... 440
Annealing of steel..... 322
Applied science..... 164
Arch bridges..... 33
Architecture..... 95
Architectural metal-work..... 392
Armor, compound..... 278
Arsenal and dock yard—Japan... 88
Artesian wells in Australia..... 352
Asiatic Railways..... 520

Banking the Tagus..... 348
Bessemer steel..... 520
Boiler furnaces for smoke prevention..... 62
Boiler surface..... 100
Bolsover dolomite..... 176
Book Notices:
Adams, J. W., Sewers for Populous Districts.... 262, 437
Ammen, D., Rear Admiral U. S. N., Interoceanic Canal Question..... 175
Badenoch, James, Art of Letter Painting..... 88
Bacon, F. W., The Richards Indicator..... 524
Bowser, Prof. E. A., Analytical Geometry..... 524
Cain, Wm. C. E., Sanitary Engineering..... 437
Clarke, G. S., Graphical Statics..... 438
Colvin, V., Survey of the Adirondack..... 351
Davies, D. C., F. G. S., Metalliferous Minerals and Mining..... 88
Debouve, A., Manuel De L'Ingenieur..... 88
De Roos, J. C., Linkages.... 175
Dittmar, W. Analytical Chemistry..... 438
Forney, M. N., M. E., Carbuilders' Dictionary..... 351
Galloway, R., F. C. S., Treatise on Fuel..... 263
Gardner, E. C., Church Building..... 175
Gurden, R. L. Traverse Tables 524
Hutchinson, E., M. I. M. E., Girder Making and Bridge Building..... 87
Jackson, L. D. A., Aid to Survey Practice..... 439
Jeans, J. S., Treatise on Steel 351
Jones, W., F.S. A., History and Mystery of Precious Stones..... 264
Ledoux, Ice-Making Machine 350
Minchin, G. M., M. A., Treatise on Statics..... 439
Penning, W. H., F.G.S., Field Geology..... 261
Pierce, Prof. J. M., Mathematical Tables..... 87
Potter, W. B., Analysis Note-Book..... 175
Proctor, R. A., Rough Ways Made Smooth..... 261
Raymond, R. W., Camp and Cabin..... 523
Sleeman, C., Torpedoes and Torpedo Warfare..... 262
Tadivala, M. K., Calculator of Measurements..... 438
Taylor, Wm. B., Electro-Magnet Telegraph..... 351

Page.

Wanklyn, J. A., Water Analysis..... 88
Wheeler, C. G., Medical Chemistry..... 174
Wilkins, Lieut.-Gen. H. St. Clair, R. E., Treatise on Mountain Roads.....

Boxwood in Russia..... 256
Breaking ice with dynamite..... 352
Breech-loading ordnance..... 87
Bridge over the Burdekin River. 133
Bridge—Tay..... 224, 435
Bridge of Lessart..... 86
Bridges, historical..... 425
Bridges..... 33
Bridging in U. S..... 296
Building an American Man-of-War..... 450
Buildings, acoustics in..... 369

Cables, rules for..... 516
Canal, Panama..... 241, 305, 314
Canals, Irrigation..... 26
Carbon and silicon..... 385
Cast iron for engineering purposes..... 17
Cast Iron, Fracture of..... 507
Cement, Portland..... 156, 463
Chicago, Lake tunnel at..... 428
Chloride for silvering ivory..... 264
Chordel..... 206
Clyde, ship-building in 1879..... 436
Coal in China..... 12
Cologne cathedral..... 176
Color-blindness..... 347
Coloring brass work..... 109
Columns, strength of..... 353
Common sense in architecture.. 95
Compound armor..... 278
Conductors for lightning..... 102
Cooling wagons for meat..... 16
Copying process, new..... 431

Dangers of bad plumbing..... 220
Decentring, New Methods of.... 455
Deepening of the Seine..... 352
Dephosphorization of iron..... 433
Diamonds, artificial..... 345
Difficulties in shaft sinking..... 428
Disposal of sewage..... 24
Dissociation of the metalloid elements..... 419
Duillo..... 437
Dwellings, sanitary constructions in..... 177, 281
Dynamo-electric machines...340, 375

Earth, size and shape of.. 53, 115, 233
Earthwork, measurement of..... 320
Education, foreign..... 253
Effective ventilation..... 13
Elasticity of materials..... 203
Electrical transmission of power 196
Electricity, nature of..... 298
Electric light, by Prof. Henry Morton..... 163, 397, 441
Endless-chain mine railway..... 521
Endless rails..... 520
Engineering..... 128
Engineering, progress in..... 1, 328
Engineering Societies:
American Society of Civil Engineers..... 85, 257, 432
American Society of Mechanical Engineers..... 432
Boston Society of Civil Engineers..... 345
Engineers' Club of Philadelphia..... 48, 169, 257, 432, 518
Institution of Civil Engineers. 257
Liverpool Engineering Society 257
Errata..... 169
Etruscan and Roman Scoria..... 170
Euphrates Valley Route to India 474

Page

Expenses and receipts on railways..... 171

Failures of axles and rails..... 348
Feat in triangulation..... 159
Filtration of water..... 72
Fire-proof buildings in Vienna.. 521
Fitzroy River..... 16
Floating fighting Island..... 86
Fluid steel, consolidation of..... 347
Formula for white enamel..... 264
Foundations, pneumatic..... 155
Fracture of Cast-Iron..... 507
Future steam engine..... 110
Gas in railway carriages..... 252
Gases, Liquids and Solids..... 472
Geographical map making..... 41
Gold in Russia..... 352
Gothard Tunnel..... 259, 348, 350
Great St. Gothard at Goeschenen 86
Gunnery experiments..... 349
Gunnery trial..... 327
Gunson's tramways..... 435

Halls, acoustics of..... 153
Hardening iron and steel..... 258
Hardening of Iron and Steel..... 485
Heberlein Brake Company..... 524
Highest houses in the world..... 176
Historical bridges..... 425
H. M. S. "Mercury"..... 260
House drainage, suburban..... 366
Hydraulics..... 429
Hydraulic brake..... 174

Ice-boat problem..... 83
Improved tramways..... 86
Incombustible wood..... 352
Indian map making..... 41
Influence of forests on rainfalls. 176
Inundations and embankments.. 173
Iron and Steel..... 104
Iron and Steel, Hardening of.... 485
Iron and steel, low temperatures. 519
Iron, Fracture of..... 507
Iron in Prussia..... 258
Iron, strength of..... 423
Ironwork..... 200
Irrigation Canals..... 26

Japanese paper mills..... 176
Krupp's Homogeneous Iron..... 85

Large forgings..... 170
Laws of Patent office..... 105
Light, electric..... 163, 397, 441
Lightning conductors..... 102
Liquids, Solids and Gases..... 472
Locomotives, Slipping of..... 471
London sewage..... 382
Long columns..... 353
Loss in Boston fire..... 175

Machinery, progress in..... 1
Magnets from soft metals..... 176
Manufacture of steel..... 519
Map making, Indian..... 41
Materials, strength of..... 203
Means adopted for Ranging a Tunnel Line..... 517
Measurement of earthwork..... 320
Metallic compound, new..... 371, 439
Metalloid elements..... 419
Method of Decentring..... 455
Mont Blanc and Simplon routes. 440
Motors, electric, by Morton..397, 441
Mountain guns..... 368

Nature of electricity..... 298
Navigable waters, bridging..... 296
Navy of the United States..... 350
New copying process..... 431
New industry for iron mills..... 86
New metallic compound..... 371, 439
Nitrogen in steel..... 258

	Page.
Notes on iron-work	200
Palliser Gun experiments	522
Panama Canal	241, 305, 314
Patent laws	105
Photography	176
Pine, strength of	166
Plumbing	220
Pneumatic foundations	151
Portland Cement	156, 463
Power, transmission of	196
Prevention of rust on pens	176
Prevention of smoke in steam boiler furnaces	62
Prismoidal formula	320
Prizes of German Railroad Union	223
Progress in engineering	1, 328
Public works engineering	1
Railroad shakes	161
Railroad signals	457
Railroad to Bagdad	347
Railway accidents	259
Railway in Ceylon	434
Railway over the Brunig	259
Railway speed	348
Railway through Col du Mont	347
Railway tunnels	171
Regelation of Metals	507
Report to Philosophical Society	175
Retaining walls	265
Route to India	474
Russian railways	16
Sanitary construction in houses	177, 281
Sanitary Engineering	128
Sanitary fallacies	28
Science applied	164
Sewage, disposal of	24
Sewage of London	382
Shakes, rail-road	161
Shape and size of the earth	53, 115, 233
Slipping of Locomotives	471
Signals on Railroads	450
Silicon and carbon	385
Silt in irrigation canals	26
Simplon tunnel	348
Smoke prevention	62
Solids, Liquids and Gases	472
South Australian railways	521
Steam engine of the future	110
Steel, hardening of	322, 345, 485
St. Gothard Tunnel, Center Line	517
Strength of iron under moving loads	423
Strength of long columns	353
Strength of materials	203
Strength of Southern and white pine	166
Suez Canal	440
Surveying, topographical	134
Swedish railways	16
Tay bridge	224, 435
Technical education	253
Teleodynamic Cables	516
Temperature zero	168, 279
Tempering of steel	322
Terra cotta	52
The Railroad outlook	521
Thermic Motors at Paris in 1878	89
Tokio, water-works of	388
Topographical surveying	134
Town water supplies	351
Tramways in Italy	171
Transmission of power	196
Transverse strength of pine	166
Triangulation, a feat in	159
Tunnel at Chicago	428
Useless boiler surface	100
Vanes, curved, water jets on	210
Ventilation	13
Violet efflorescence	32
Viscosity of Metals	507
Walls, retaining	265
War-Ship Building	450
Water, filtration of	72
Water jets on curved veins	210
Water supply, suburban	366
Water-works of Tokio	388
Wedging of blasting in coal mines	88
White pine, strength of	166
Woolwich and Krupp guns	172
Woolwich pattern-gun	437
Zero, absolute	168, 279

ERRATA.

Page	Col.	Line	Should read	Instead of
136	II	3 from bottom	$MF=c+GF=c+k.CD$; $MF=\frac{D}{\cos n}$	$MF=c+GF=c+k.CD$. $MF=\frac{D'}{\cos n}$
137	"	11 " top	D'	d'
"	"	3 " bottom	$\frac{AF \sin n \sin m}{\cos n \cos m}$	$\frac{AH \sin n \sin m}{\cos n \cos m}$
138	"	5 " top	term	form
"		table in column 3.00 20°	0.82	0.32
139	I	16 from top	c	t
"	II	12 & 13 " "	(u)	(n)
"		in last column of table	1.313	1 318 (first)
140		in first column of table	25	24
"	I	22 from bottom	$(o-u)$	$(o-n)$
"	"	28 " "	$(m-u)$	$(m-n)$
141	"	23 " "	at least	at most
142	"	1 " top	painting	pointing
"	"	9 " "	target	largest
144	II	6 " "	secured	served
"	"	10 " bottom	contour-lines	constant-lines
149	I	4 " "	logarithms	irlogirithms
216	II	9th line for ω_1, read w_1.		
217	I	1st line for dv, read dr.		
"	"	11th line insert sin μ between wr and $[1-\cos d\gamma]$		
219	I	below the middle, in value of M, insert r between sin μ and the bracket (brace).		
219	II	in the first five lines for $d\lambda$, read $d\theta$.		
220	I	fourth line, for c, read c_0.		